REMARKS

Claims 16-30 are pending in the present application. Reconsideration of the claims is respectfully requested.

CLAIM REJECTION

35 U.S.C. 103(a) rejection over the '123 Publication

The Examiner has rejected claims 16-30 under 35 U.S.C. 103(a) for obviousness over PCT Patent Publication No. WO 02/081123 A2 to Richaud ("the '123 publication"). The Examiner cites the '123 publication as teaching that the placement of perturbations on the surface of a stopper rod and/or nozzle at locations where clogging through precipitation on the refractory component would occur reduces clogging at those locations. The Examiner also asserts that the perturbations of the '123 publication operate in substantially the same manner as the ripples of the present invention.

Applicant notes that the perturbations of the '123 publication and the ripples of the present invention are similar in neither form nor function. A perturbation according to the '123 document "interrupts the boundary layer…" (p. 9, line 4). This description corresponds to the illustrations of the '123 document, in which all the perturbations depicted introduce a constriction between a stopper rod and a nozzle.

The introduction of a constriction in the flow path of the device of the '123 publication produces effects that are absent from the device of the present invention. These effects are exemplified by the situation in which a step is cut into the nozzle seat, as in the '123 patent. The step deflects the streamlines upstream of the step. The step forces the streamlines to deviate towards the nozzle seat where the step is located. The step creates a recirculation zone with velocity vectors turning in the same direction as the streamlines causing the streamline deviation towards the nozzle seat.

In contrast to the cited prior art, the flow channel size of the device of the present invention does not decrease as a function of the distance downstream from the aperture (see [0029]). Instead, the flow channel size downstream of the aperture increases in a series of steps. Streamlines are not altered by a flow obstruction, but rather by detachment from a surface as a result of flow channel widening. Only the boundary layers are perturbed by recirculation or detached flows. The ripples force the streamlines to deviate away from the stopper nose where

the ripples are located. The ripples promote the generation of a powerful circulatory flow downstream of the ripples that pushes the streamlines away.

The recirculation regions formed in such a configuration are more controllable, in terms of size and location, than the turbulent eddies formed by a constriction (see, e.g. [0030], and are thus more suitable for situations in which a controlled eddy is needed to sweep unwanted particles away from a given location (see [0031]).

In addition, the seat/stopper combination of the present invention does not contain volumes in which unwanted particles are likely to accumulate. The step in the seat of the '123 publication device contains such a volume: the step interrupts streamlines and draws flow into a volume above the step. In the present invention, circulatory flow is downstream of the ripples and directs flow away from the ripples. Unwanted particles are thus unlikely to accumulate in the ripples, as is shown in the accompanying illustrations.

The device of the present invention differs from the cited prior art in having a distinguishable configuration performing a distinguishable function. The ripples claimed in the present application have neither a literal nor a functional equivalent in the '123 publication. For these reasons, the rejection of claims 11-20 under 35 U.S.C. 103 (a) is believed to have been overcome.

Applicant respectfully submits that claims 11-20 are patentable over the prior art. Early and favorable action is earnestly solicited.

Date: July 18, 2008

Respectfully submitted,

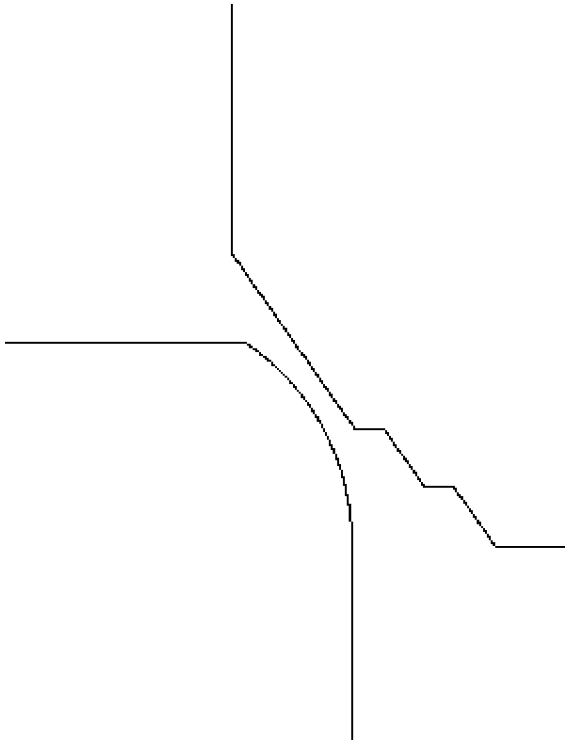
Vesuvius
250 Park West Drive
Pittsburgh, PA 15275
(412) 429-1800 x6921, (412) 429-3448 fax.

Thomas J. Clinton
Reg. No. 40,561
thomas.clinton@us.vesuvius.com

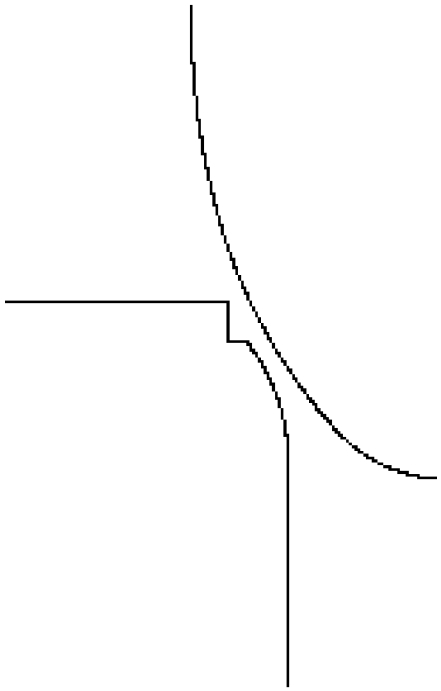
Comparison of ripple stopper geometry (present invention) and seat step geometry (prior art):

For comparisons of flow patterns

- identical mesh size (0.25 mm) and identical inlet and outlet boundary conditions were used.
- the step was cut into the nozzle seat.
- The ripples were cut from the multiradius profile.

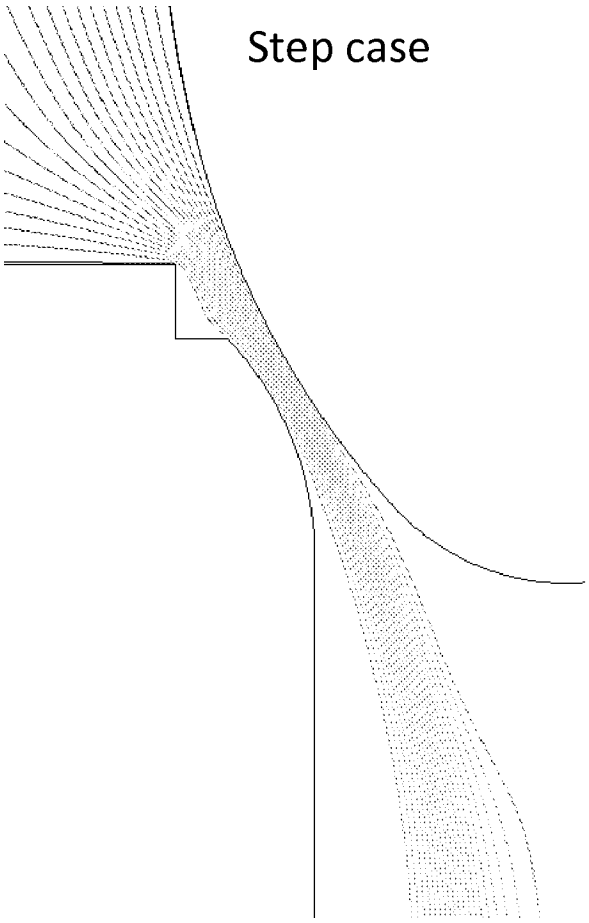


Ripple stopper geometry

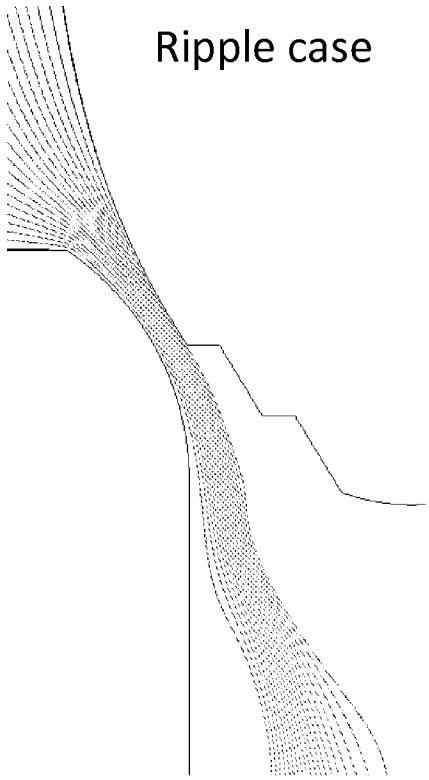


Step geometry

Step case

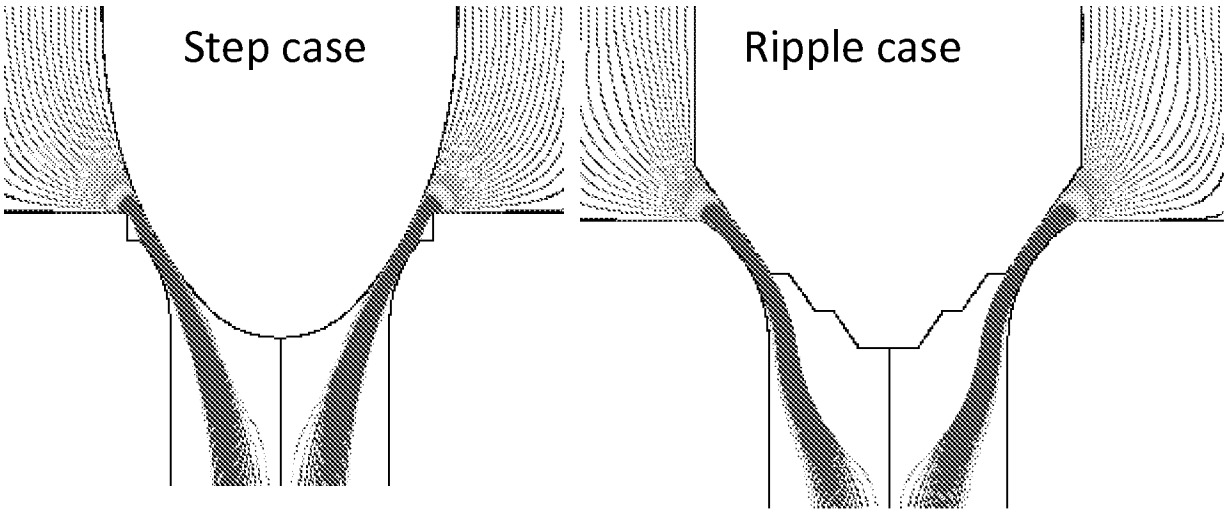


Ripple case



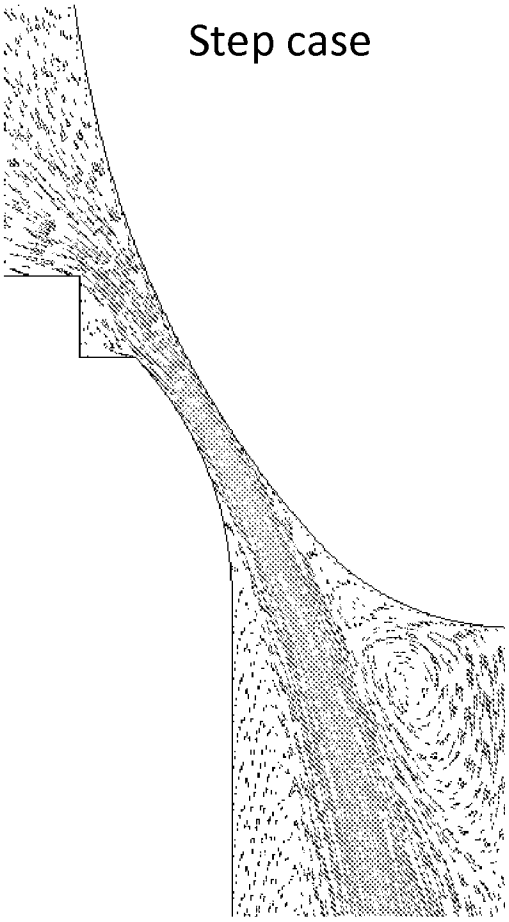
The step deflects the streamlines upstream of the step.
The step forces the streamlines to deviate TOWARDS the nozzle seat where the step is located.

The ripples force the streamlines to deviate AWAY from the stopper nose where the ripples are located.



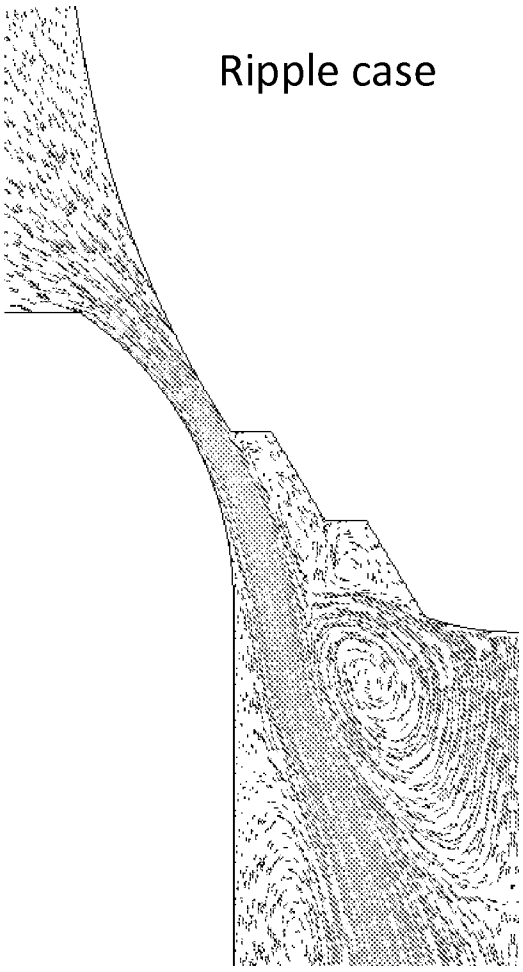
The step does not modify the trajectory of streamlines downstream, whereas the ripple surface stabilizes a recirculation region that interacts with the streamline trajectories.

Step case



The step creates a recirculation zone with velocity vectors turning in the same direction as the streamlines causing the streamline deviation towards the nozzle seat. The recirculation zone is above the step and deviation is towards the seat; these factors both increase the likelihood of accumulation of material above the step.

Ripple case



The ripples promote the generation of a powerful circulatory flow downstream of the ripples that pushes the streamlines away. The recirculation zone is below the ripples and deviation is away from the ripples; these factors both decrease the likelihood of accumulation of material on the stopper or nozzle.